“Agro-Climatic Study in Eastern Part of Marathwada”

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INTRODUCTION

One of the most important aspects of the earth's surface is climate. It has an impact on both living and non-living entities. However, there is a variation in environmental factors. Climate fluctuates throughout time and space as well. The number of scholars from various fields, such as meteorology, agriculture, environment, biology, hydrology, are engaged over a long period of time to acquisition and application of knowledge of natural aspects for the adequate life (Shinde and Khadke, 2021).

Gho Cheng Leong (1971) describe the climate term as, it is the average atmospheric condition of an area over a considerable time. According to WHO climate is nothing but the aggregate of climatic elements over a long period of time, that period of time is 30 years. The term climatology is the scientific study of climate or average of the long term state of the atmosphere includes the aggregate effect of day to day weather phenomena (K. Siddhartha and S. Mukharjee).

There are relationships between these two branches. In contrast to climatology, which focuses on long term weather lasting up to a few weeks, climatology studies the frequency and trends of those systems. It studies the periodicity of weather events over years to millennia, as well as changes in long-term average weather patterns, in relation to agriculture conditions. According to **Chritchfield (1975)** the climatology is the finding of meteorology in space and times.

Climatology and Geography:

The geography studies the Physical and Cultural phenomena over the earth surface. In the study of physical and Cultural geography the climate is essential part. The geographical location and altitude are influence over the climatic element. Therefore, these subjects are depending to each other.

According to **Riley and Spolton (1974)**, “The distribution of atmospheric phenomena over the earth is differentiated by latitude, topography, altitude, distribution of land, sea, and icecaps, and also, to some extent, by forests and great cities. All these influences are agroclimatic. The geographers, among other social scientists, are engaged in long- term acquisition and application of environmental knowledge”.

According to **F. Kenneth Hare (1961),** "Climatology is an integral part of agriculture geography, perhaps closer to the centre than any other".

Agro-Climatic Condition and Productivity distribution pattern of different crop in India, the variation of crops yield and distribution of area from place to place and season to season, Climatic factors influencing crops productivity ,Temperature is major factor to change crops productivity .The entire country has been classified in high ,medium and low annual Climatic parameters .Rising Temperature and extreme Climatic events adversely affect Maharashtra's Agriculture productivity The study future climatic scenario over the Marathwada region .special Eastern Marathwada (Nanded, Parbhani, Hingoli, Latur) To study about agro-climatic condition yield of sugarcane Wheat ,Rice ,Jowar and other crops

To using applied statistical techniques therefore results from past agro-climatic study and Temperature and rainfall patterns in Eastern Marathwada correlated to changing crop productivity in this Region. Crops like Jowar, Bajara, Pulses, Sugarcane and others.

The agro-climatic classification study is importance for the suitability to agriculture. the rainfall is most influencing factors in agro-climatic zone. the study suitability of climate for each crop is different because each crops having their own climatic factors. this study focused on the agro-climatic region of eastern Marathwada (Nanded, Parbhani, Latur, Hingoli)

REVIEW OF LITERATURE:

Aditi Sarkar (2008); Studied the geospatial technique in soil and climatic data analysis for agro-climatic suitability evaluation of important crops in rain-fed Agro-ecosystems in Madhya Pradesh. The current research focuses on assessing agro-climatic soil suitability for land use using the FAO and AEZ approaches, as well as Remote Sensing and Geographical Information Systems. The soil productivity was also measured. This evaluation is based on the soil-water interaction, potential evapotranspiration, and the length of the growing season for the crops.

Ajay Kumar and Pritee Sharma (2013); The influence of climate change on agricultural output and food security in rural India was investigated. They went into greater detail about the relationship between agricultural productivity and climate. Basically, the production value of food grain and non-food grain crops. They also created the food security index by

analysing food production availability, stability, and accessibility, as well as poverty in India. The impact of climate variables, socioeconomic variables, and policy variables on India's food security was also explored.

Alexander Michael de Sherbinin (2014); Paid attention on the “Mapping the unmeasurable Spatial Analysis of Vulnerability to climate change and climate variability”. Focused on quantitative and qualitative analysis to better understand patterns of climate change susceptibility. The relative benefits of several techniques to understanding what lies underlying the spatial pattern of susceptibility were also investigated and discussed. The use of the enhanced vulnerability framework established by a Harvard and Clark University research team was also investigated.

Amitta Prabhu (2011); Study was conducted on the fluctuation of Polar Sea Ice and its possible links with monsoon. The technology of remote sensing is employed. The topic of summer monsoon rainfall over India, as well as its background and long-term forecasting situation, is explored here. Polar sea ice and its interannual and seasonal variations were also a major topic. In addition, the impact of Antarctic sea ice and its surrounding oceans on India's summer monsoon rains is discussed. Sea ice, as previously said, is an important component of the global climate system and its seasonal, regional, and interannual variability.

Aype Thomas P (2005); Investigate the seasonal, inter annual, long-term and decadal variability during southwest monsoon season over Kerala state of India. Also focused on the study of relationship between global circulation parameters with rainfall of Kerala. The influence of orography of Western Ghats on rainfall of Kerala. In this study seasonal variability of rainfall assessed by using wavelet analysis method for summer of 95 years. It is found that the eleven years are not significant. The inter annual variability is assessed by using long term mean and standard deviation. It is noted that the rainfall of Kerala is controlled by low level Jet Stream and orographic control of Western Ghat.

Gilbert Muthee Mwoga (2014); The assessment of perceived and observed evidence of climate variability in Kenya's Meru county has been completed. Also look at the link between land use change and climate variability, as well as the impact on livelihood. Climate variability is linked to landuse change in a short period of time, according to the findings of the study. The change in farming practises was affected by seasonal rainfall fluctuation.

Changes in rainfall are an important indicator of climate change. It's thought that rainfall variability was more influential in the first season than in the second. As a result, more care should be taken while planning land practises during the seasons.

Godbole R.V. (1971); The simulation and climatology of the Indian summer monsoon were evaluated. For the investigation, a wet and dry simulation model was used. Moisture is also important for the occurrence of rainfall, not just for influencing monsoon circulation. It was also discovered that the presence of the Himalaya is the most important factor in the establishment of monsoon circulation. It should also be noted that the simulated temperature pattern resembles the actual temperature field. Tropopause height increases with latitude south of the Himalaya. Furthermore, the horizontal heat gradient within the upper troposphere is greater than 0.50C/degree Latitude, which is higher than what the monsoon circulation would create.

Liberata (2004); The distribution and variability of rainfall from 1950 to 2000 were investigated. Focused on the relationship between Myanmar's environmental situation and rainfall variation with regard to the wood fuel issue in two regions: Ay eyawad Pelta and Myanmar's Drv Zone. This research found that worldwide circulation has a connection to monsoon rain in Myanmar. However, the circulation in the winter has a significant low frequency in rainfall variability. It is the outcome of shifting and intensifying Jet Streams and storms, as it is influenced by temperature and precipitation. EL Nino has an impact on the driest months.

Lorna R. Nayagam (2012); Rainfall variability is discussed, as well as the impact of orography and land use on the climate of peninsular India. The longterm, interannual, intraseasonal, and diurnal variability in temperature and rainfall over Peninsular India was investigated. It was discovered that interannual variability is dominantly periodic at a 2-8 year scale and is linked to ENSO (El Nino Southern Ocealation) variation.

Samir Pokhrel (2004); Attempt has been made on the study of Estimation of rainfall and its variabilities, through space based observation.

Saranya A. and Payal S. P.(2017), Investigated temporal variation of meteorological parameters that is rainfall and temporal with their trend for 1994 to 2014 for marathwada

region. The statistical parameters have been used for calculation of annual and seasonal variation. The trend analysis of climatic parameters was performed by using Mann Kendalls test at 95% probability level.

Shaikh Irfan Ahmed (2013); Described that the rainfall based cotton yield Models in Marathwada. Focused on cash crop cotton its production, yield crop area, its growth rate, relation between prices of cotton and production and area. Also he prepared district wise cotton yield models based on rainfall.

Shukla and Fennessy (1994); Examined that the annual cycle of Sea Surface Temperature (SST) in Indian ocean plays an key role to setup the rainfall and circulation over the Indian monsoon region.

Sunita Chaudhary (2005); Have been studied the "Climatic variability, acreage response and cropping pattern in U P: A Geographical study". She examined the pattern and variability of rainfall in Utter Pradesh. Also studied the productivity of crops in pre monsoon, during monsoon and post monsoon season and its relationship with rainfall. She analysis the rainfall variability by monthly, seasonally and annually, its impact on change in cropping pattern with spatial reference of eastern Utter Pradesh. She observed that the monsoon rainfall s positively effect on kharif crops and their productivity.

Vanacker et.al. (2005); Pointed out that the several ecosystems are highly sensitive to availability of water which highly correlated to climate variability in Sub Saharan Africa. It is due to the water resources are the integral part of global hydrological cycles on the planet Earth. The process of evaporation of land and ocean promotes to start the precipitation. The aquifer water does not evaporate and could not help to built streams and rivers.

V. Madhava Rao et.al. (2008); Have been prepared to agriculture and natural landuse/landcover, cropping system, cropped area under irrigation, drainage pattern in Uttarakhand state of India under the study of Agro-climatic planning and information Bank for Uttarakhand state, India.

OBJECTIVES:

The main objective of this study is to investigate the spatial distribution of rainfall in eastern part of Marathwada with relation of agriculture land use. The main objectives of the study are as follows:

1) To study the spatio-temporal rainfall scenario in study region.
2) To analyse the impact of rainfall on spatio-temporal variation in agricultural land use.
3) To classify agro- climatic region based on rainfall and temperature of the study region.
4) To check the relation between crops and rainfall variation of the study region.
5) To classify agro- climatic region based on rainfall and temperature of the study region
6) To study the impact of rainfall variation on farmer suicide in study region.
7) To demarcate future trend of climate elements.

STUDY AREA:

The choice of the area eastern Part of Marathwada and topic has influenced by several consideration, Eastern part of Marathwada having four district Nanded, Parbhani, Hingoli Latur the study area lies between

Marathwada located in centre part of Maharashtra the eastern part of Marathwada Nanded district share the boundary between Telangana state, Latur district share with Karnataka state and Osmanabad district west Marathwada. Hingoli and Nanded district share their boundary with Vidharbha Region district of Yavatmal and Washim, Parbhani located between Hingoli and Latur share boundary with Beed and Jalna district to western Marathwada

DATA BASE AND METHODOLOGY

AGRICULTURAL DATA

Agricultural data will collect by various sources the data is related to the cropping pattern, cropping area, types of the crops, net sown area, gross cropped area, Crop yield, crop productivity, agricultural land use this data will collect for the year 1991 to the year 2021, and for the research decadal data will analyse decades are categories as year 1990-1991, year 2000-2001, year 2010-2011 and year 2020-2021 the data will collect from following sources

1. District Gazetteer of Nanded, Parbhani, Hingoli, Latur
2. Agricultural Department of Maharashtra State (www.mahaagri.gov.in)
3. Divisional Agriculture Department, Pune
4. Directorate of Agriculture, M.S. Pune and District Inspector Land Records,
5. Socio-Economic Abstract District Nanded. Parbhani, Hingoli, Latur

CLIMATIC DATA

Climatic data will be collect by various sources the data is related to the Rainfall pattern, Temperature, Wind System, Potential Evapotranspiration (PET), Rainy Days, Precipitation, Moisture, Relative Humidity ,Thunderstorms, Cloud Cover, Sunshine, this data will collect for the year 1991 to the year 2021, and for the research data will be analyse with the help of various statistical methods in the form of average, variation, standard deviation, skewness, kurtosis etc. details of data collect from following sources are mention as below.

1. India Meteorological Department (IMD) Shivajinagar, Pune.

The research study broadly contained the following step.

MEAN

Mean will calculated by using the following formula.

$$\bar{X} = \frac{\sum x}{n}$$

Where, $\bar{x}$ = mean, Σx = is the sum of the value, n = total number of values.

INDEX OF LAND USE EFFICIENCY (JASBIR SINGH'S METHOD)

$$\text{Index of Land Use Efficiency (LUEI)} = \frac{\text{Gross Cropped Area}}{\text{Net Sown Area}} \times 100$$

INDEX OF CROP DIVERSIFICATION (BHATIA (1965).

$$\text{Index of Crop Diversification} = \frac{\text{Percentage of Sown Area under X Crops}}{\text{Number of X Crops}} \times 100$$

(Whereas 'X' Crops are those crops occupy 10% or more of the Gross Cropped Area in the area under study)

CROP COMBINATION (Weaver's method)

$$d = \frac{\sum d2}{n}$$

Where, d = difference between the actual crop percentages in a given region

n = total number of crops in given combination.

AGRICULTURAL DENSITY

$$\text{Agricultural Density} = \frac{\text{Total Agricultural Population}}{\text{Net Sown Area}} \times 100$$

STANDARD DEVIATION

$$\text{Standard Deviation (SD)} = \frac{\sqrt{\sum(x - \bar{x})^2}}{n}$$

Where, x= given Value

$\bar{x}$ = mean

Σx = is the sum of the given value

n = total number of values.

COEFFICIENT OF VARIATION

Formula for C.V. = S/M *100

Where, C.V.is co-efficient of variability,

S is the standard deviation,

M is the mean

TREND ANALYSIS, MOVING AVERAGE METHODS AND A LINEAR CORRELATION REGRESSION

Correlation Regression line has an equation of the form

Y = a + bX,

Where, X is the explanatory variable and

Y is the dependent variable.

The slope of the line is b, and a is the intercept (the value of y when x = 0).

SKEWNESS

Skewness is positive or negative distribution according to the mean and median. It is useful for the identification of symmetrical distribution of data. Positively skew distribution curve rises rapidly and falls slowly, while negative skew distribution cures rise slowly and fall rapidly. The symmetry of the rainfall distribution curve will measured by using the skewness.

KURTOSIS

Kurtosis is useful for understanding the nature of curve around the mode. If curve is more peaked around, the mode is called leptokurtic. Where curve is more flatted than the normal is called platykurtic and the normal curve itself is called mesokurtic.

Data collection the research will be based on secondary data collected from government department. The data related to climate will be collected from meteorological department and the crop production data will be obtained from agriculture department of Maharashtra. The data will be presented in graphical and statistical from through tables, graphs, and Maps.

Primary data will gather from formers and villages using particular questionnaires and information will be receive from a number of sources.

Secondary data from socio- economic review, district census, gazettes, agriculture social and economic publications journal as well as from various government offices. And non-government Department will be use to create a comprehensive picture of the current agriculture, social and economical pattern.

To prepare LULC map used Landsat 5 , Landsat 7 and Landsat 8 satellite data using .Satellite image data will treated ERDAs and Arc-GIS software.

Statistical Method, Mean, mode, medium, co-relation, SD (Standard Deviation) regression, T-test, Climate Variability rainfall trend analysis, Uncertainties.

Map Diagrams, photographers and other analytical Methods.

SCHEME OF CHAPTER

The research work entitled **"Agro-Climatic Study in Eastern Part of Marathwada"** will be framed into seven chapters that are follows:

Chapter 1st **"Introduction"** will consist of introduction of Rainfall, Study area, Objectives of research, Data, Methodology, Scope, Importance and Limitation of study, Literature review and Scheme of chapter.

Chapter 2nd **"Physical Setting of Eastern Part of Marathwada"** In this chapter, Physical Setting of Eastern Part of Marathwada, including the location, physiography, climate, drainage, soils and natural vegetation etc

Chapter 3rd **"Rainfall Pattern in Eastern Part of Marathwada"** associated with the Monsoon reliability, Rain gauge stations, Latitudinal, Longitudinal, altitudinal distribution of rainfall.

Chapter 4th **"The relation between crops and rainfall variation of the study area"** consists with the impacting factors on rainfall,

Chapter 5th **"Classify agro- climatic region based on rainfall and temperature"** deals with trend and symmetry of rainfall.

Chapter 6th **"The impact of rainfall variation on farmer suicide in study region**." includes the analysis of monsoon reliability with farmer suicide in the study region.

Chapter 7th **"Summary and Conclusion"** consists with the concluding remark and recommendation of research output.

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